

MRI – MCQ 1

(1) Which would not be useful for medical MR imaging?

- ☐ (A) ^1H
- ☐ (B) ^{13}C
- ☐ (C) ^{16}O
- ☐ (D) ^{23}Na
- ☐ (E) ^{31}P

Question 1: Correct answer is C

Explanation: ^{16}C is an example of an even-even nucleus (eight neutrons and eight protons), which has no magnetic moment and thus cannot be used for MR.

(2) The Larmor frequency is the frequency of:

- ☐ (A) Pulse repetition
- ☐ (B) Nuclear precession
- ☐ (C) Phase encoding
- ☐ (D) Spatial encoding
- ☐ (E) Gradient switching

Question 2: Correct answer is B

Explanation: Magnetic nuclei precess at the Larmor frequency when placed into a magnetic field.

(3) The resonance frequency for ^1H in a 1.5 T magnetic field is:

- ☐ (A) 63 Hz
- ☐ (B) 63 kHz
- ☐ (C) 63 MHz
- ☐ (D) 63 GHz
- ☐ (E) 63 THz

Question 3: Correct answer is C

Explanation: 63 MHz.

(4) The maximum MR signal is obtained by using a:

- ☐ (A) 90 degree RF tip, short TE, and short TR
- ☐ (B) 45 degree RF tip, short TE, and short TR
- ☐ (C) 90 degree RF tip, short TE, and long TR
- ☐ (D) 90 degree RF tip, long TE, and short TR.
- ☐ (E) 45 degree RF tip, long TE, and short TR

Question 4: Correct answer is C

Explanation: Maximum signal strength is obtained by using a 90 degree pulse to maximize the magnetization in the transverse plane, starting with the maximum longitudinal magnetization (i.e., long TR) and minimizing dephasing (i.e. .. short TE).

(5) For most tissues, which of the following is false?

- ☐ (A) T1 is of the order of a few seconds.
- ☐ (B) T2 is of the order of tens of milliseconds.
- ☐ (C) T2 is relatively independent of field strength..
- ☐ (D) T1 increases as field strength increases.
- ☐ (E) T1 and T2 often increase with malignancy.

Question 5: Correct answer is A

Explanation: T1 is of the order of hundreds of milliseconds, not a few seconds.

(6) The small amount of bound water produces no detected MR signal because:

- ☐ (A) T1 is too short
- ☐ (B) T2 is too short
- ☐ (C) T2* is very long
- ☐ (D) T2 is longer than T1
- ☐ (E) T2* is longer than T2

Question 6: Correct answer is B

Explanation: The T2 is too short (microseconds) to give rise to a detected signal from all solids including bone.

(7) For most biological tissues, T2 is:

- ☐ (A) Less than T1
- ☐ (B) More than T1
- ☐ (C) Less than T2*
- ☐ (D) More than 100 milliseconds
- ☐ (E) Less than 5 milliseconds

Question 7: Correct answer is A

Explanation: T2 is generally of the order of tens of milliseconds, whereas T1 is on the order of hundreds of milliseconds.

(8) MR "shimming" is used to:

- ☐ (A) Minimize noise in RF coils
- ☐ (B) Correct for magnetic-field inhomogeneities
- ☐ (C) Reduce the noise level in MR systems
- ☐ (D) Minimize the possibility of quenches
- ☐ (E) Increase signal phase

Question 8: Correct answer is B

Explanation: Shimming is used to reduce field heterogeneities to a few parts per million.

(9) The superconducting magnets used in MR normally have:

- ☐ (A) No magnetic-field inhomogeneities
- ☐ (B) Water cooling to dissipate heat production
- ☐ (C) Coils with alternating electric currents
- ☐ (D) Magnetic fields perpendicular to the bore axis
- ☐ (E) Liquid helium coolant

Question 9: Correct answer is E

Explanation: Superconductors normally require liquid helium coolant.

(10) Gradient fields in MR are used most commonly to:

- ☐ (A) Increase T2
- ☐ (B) Shorten T1 values
- ☐ (C) Localize MR signal source

- ☐ (D) Increase signal in large patients
- ☐ (E) Reduce electronic noise

Question 10: Correct answer is C

Explanation: Gradients define the MR image plane and are used for frequency and phase encoding to determine the spatial origin of the detected signals.

(11) Which of the following is generally acceptable for MR at 1.5 T?

- ☐ (A) Cochlear implants
- ☐ (B) Pacemakers
- ☐ (C) Ferromagnetic aneurysm clips
- ☐ (D) Claustrophobic patients
- ☐ (E) Pregnant patients

Question 11: Correct answer is E

Explanation: Pregnant patients can undergo MR scans (no ionizing radiation).

(12) Which line is an exclusion zone for persons with pacemakers?

- ☐ (A) 0.5 G
- ☐ (B) 5G
- ☐ (C) 50G
- ☐ (D) 500 G
- ☐ (E) Over 500 G

Question 12: Correct answer is B

Explanation: Areas with magnetic fields greater than 5 G (0.5 mT) should be restricted to individuals with pacemaker implants.

(13) Safety concerns for 1.5 T MR include all of the following except:

- ☐ (A) Fringe magnetic fields
- ☐ (B) Electrical stimulation neurons
- ☐ (C) RF heating effects
- ☐ (D) Ferromagnetic surgical clips in patients
- ☐ (E) Flying metallic objects

Question 13: Correct answer is B

Explanation: For magnetic-field strengths below 2 T, the effect of magnetic field-induced electrical potentials in neurons has not been observed.

(14) The FDA limit on power deposition in patients undergoing MR does not include:

Question 14: Correct answer is D

Explanation: There are no specific temperature rise limits set for the heart by the FDA in MR.

- ☐ (A) 3.2 W/kg averaged over the head
- ☐ (B) 8 W/kg peak value
- ☐ (C) 0.4 W/kg averaged over body
- ☐ (D) A less than 3°C temperature rise in the heart
- ☐ (E) A less than 1°C core body temperature rise

(15) The most common reconstruction method for MR units is:

- ☐ (A) 2DFT
- ☐ (B) 3DFT
- ☐ (C) Algebraic reconstruction
- ☐ (D) Back projection
- ☐ (E) Filtered back projection

Question 15: Correct answer is A

Explanation: 2DFT is standard on virtually all commercial MR units.

(16) Which does not generally affect the total patient examination time in MR?

- ☐ (A) Read encode matrix size
- ☐ (B) Number of phase-encoding steps
- ☐ (C) Number of pulse sequences used
- ☐ (D) Acquisitions (N_{ex})
- ☐ (E) TR

Question 16: Correct answer is A

Explanation: The number of pixels in the read-direction is related only to the number of samples in FID acquired and will not affect image acquisition time.

(17) In spin-echo imaging, the echo signal normally is measured:

- ☐ (A) Immediately ($t = 0$)
- ☐ (B) After time TE
- ☐ (C) After time $4 T_1$
- ☐ (D) After time T_2
- ☐ (E) After time TR

Question 17: Correct answer is B

Explanation: A phase-refocusing 180 degree pulse is applied at time $TE/2$, which results in an echo at time TE.

(18) In IR sequences, the T_1 value is the time:

- ☐ (A) Of the complete scan
- ☐ (B) To the interval echo
- ☐ (C) Between successive 90 degree pulses
- ☐ (D) Between successive 180 degree pulses
- ☐ (E) Between an initial 180 degree and subsequent 90 degree pulse

Question 18: Correct answer is E

Explanation: An IR sequence starts with a 180 degree inversion pulse followed by a 90 degree readout pulse after time T_1 .

(19) Increased signal intensity in MR cannot arise as a result of:

- ☐ (A) Short T_1
- ☐ (B) Long T_2
- ☐ (C) Flow effects
- ☐ (D) Spin density
- ☐ (E) Dephasing effects

Question 19: Correct answer is E

Explanation: Dephasing effects always reduce signal intensities (they may increase contrast, but not signal intensity per se).

(20) MR SNR cannot be improved by increasing the:

- ☐ (A) Matrix size
- ☐ (B) Number of acquisitions
- ☐ (C) Static magnetic-field strength
- ☐ (D) Section thickness
- ☐ (E) RF coil sensitivity

Question 20: Correct answer is A

Explanation: Increasing the matrix size will not increase SNR but will reduce the SNR per pixel.

(21) Chemical shift artifacts are caused by:

- ☐ (A) Different resonant frequencies of ^1H in water and fat
- ☐ (B) Foreign chemicals agents in the patient
- ☐ (C) Magnetic-field gradients
- ☐ (D) Contrast agents
- ☐ (E) Spin-lattice interactions

Question 21: Correct answer is A

Explanation: Chemical shift artifacts arise because of the slightly differing resonance frequencies of protons in different molecules.

(22) In MR, motion results in ghost images that appear in which direction?

- ☐ (A) Read encode
- ☐ (B) Phase encode
- ☐ (C) Slice selection axis
- ☐ (D) PA
- ☐ (E) Lateral

Question 22: Correct answer is B

Explanation: Motion usually appears as a series of ghost images of reduced intensity displaced in the phase-encoding direction.

(23) All of the following are MR artifacts except:

- ☐ (A) Chemical shift
- ☐ (B) Bounce point
- ☐ (C) Zipper
- ☐ (D) Susceptibility
- ☐ (E) Reverberation

Question 23: Correct answer is E

Explanation: Reverberation artifacts occur in ultrasound.

(24) Superparamagnetic materials are not:

- ☐ (A) Small particles (smaller than 350 Å)
- ☐ (B) Single domains
- ☐ (C) Strongly magnetic
- ☐ (D) Related to ferromagnetic materials
- ☐ (E) Superconductors

Question 24: Correct answer is E

Explanation: Superparamagnetism has no relation to superconductivity

(25) Contrast in MR can be due to all the following differences except:

- ☐ (A) Presence of flow.
- ☐ (B) Proton density
- ☐ (C) T1.
- ☐ (D) Atomic number
- ☐ (E) T2

Question 25: Correct answer is D

Explanation: Atomic number (Z) does not give rise to image contrast in MR but does give rise to image contrast in x-ray imaging.

(26) Proton relaxation by Gd-DTPA is owing mainly to the effect of the:

- ☐ (A) Gadolinium nucleus
- ☐ (B) DTPA

- ☐ (C) Unpaired gadolinium electrons
- ☐ (D) Gadolinium K-edge energy
- ☐ (E) K-shell electrons

Question 26: Correct answer is C

Explanation: The seven unpaired electrons in Gd result in the relaxation of adjacent nuclei.

(27) Common MR angiography techniques are based on:

- ☐ (A) Phase contrast
- ☐ (B) Phase encoding
- ☐ (C) T1 contrast
- ☐ (D) Time to inversion
- ☐ (E) FSE imaging

Question 27: Correct answer is A

Explanation: Phase-contrast and time-of-flight are the two methods used in MR angiography.

(28) EPI generally requires all of the following except:

- ☐ (A) Gradient-recalled echoes
- ☐ (B) Gradients between 20 and 60 mT/m
- ☐ (C) Rapid gradient switching
- ☐ (D) High magnetic fields
- ☐ (E) Rapid repetition of 180 degree RF pulses

Question 28: Correct answer is E

Explanation: No MR sequences require a rapid set of RF

(29) MR spectroscopy is used to detect all the following except:

- ☐ (A) ^{31}P
- ☐ (B) ^{32}P
- ☐ (C) Inorganic phosphate
- ☐ (D) Phosphocreatinine.
- ☐ (E) Adenosine triphosphate

Question 29: Correct answer is B

Explanation: ^{32}P is a radioactive beta emitter used as a tracer in biomedical research, as is not used for MR spectroscopy

(30) Functional imaging using magnetic resonance does not show:

- ☐ (A) Brain activation sites
- ☐ (B) Increased venous oxygenation
- ☐ (C) Increased spin density sites
- ☐ (D) Superior temporal resolution to positron emission tomography (PET)
- ☐ (E) Superior spatial resolution to PET

Question 30: Correct answer is C

Explanation: Functional MR has no direction relation to spin density.